

Winter melanism in *Penicillifera lactea* (HUTTON 1865 [1864–66]) in the Kumaon Himalaya, India (Lepidoptera, Bombycidae)

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Abstract: Apparently cold induced melanism (“rufinism”) is reported in *Penicillifera lactea* (HUTTON 1865 [1864–66]), the first record of this phenomenon in the Bombycidae.

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Zusammenfassung: Ein offensichtlich durch Kälte induzierter Melanismus („Rufinismus“) wird von *Penicillifera lactea* (HUTTON 1865 [1864–66]) berichtet, ein Erstnachweis dieser Erscheinung bei den Bombycidae.

Introduction

The Bombycidae are a small family of moths best known for the silk they use to construct their cocoons. The domesticated moth, *Bombyx mori* (LINNAEUS 1758), is known to have been indigenous to China (HAMPSON 1892). There are no known wild populations of this moth, although it has been suggested that the wild Chinese moth *Bombyx mandarina* MOORE 1872 is the wild ancestor of *B. mori* (WATSON & WHALLEY 1983). If this is true, then it implies that the largely brown *B. mandarina* became white with domestication. (If these two are conspecific,

the name *mori* has priority, and the wild form might then be called a forma or subspecies *mandarina* of *B. mori*.)

Besides the above putative case, no pronounced melanism or albinism has been reported among the Bombycidae, although the markings in some strains of the domesticated *B. mori* are almost entirely obsolete (HAMPSON 1892).

Of the wild bombycids, 8 species have been reported from the western Himalaya so far, particularly from the Kumaon Himalaya west of Nepal (SMETACEK 2011). The flying time of these is usually restricted to the summer months between April and September. One species, *Penicillifera lactea* (HUTTON 1865), is on the wing throughout the year at Jones Estate (1500 m), Bhimtal, in Nainital district of the Kumaon Himalaya, Uttarakhand state, India.

Material and methods

Moth populations have been studied at the address above since 1973, first by my late father, Fred SMETACEK sr., and since 1983 by me. For many years, especially through the



Figs. 1–4: *Penicillifera lactea*, normal whitish and darkened (melanic) forms. All specimens recorded in Jones Estate, 1500 m, Bhimtal, Nainital, Kumaon Himalaya, Uttarakhand, India; all in coll. P. SMETACEK. **Fig. 1:** x. 1993, ♂ (normal). **Fig. 2:** 15. ix. 2003, ♀ (normal). **Fig. 3:** 8. xii. 1998, ♂ (melanic). **Fig. 4:** 21. i. 2004, ♂ (melanic). — Scale bars = 1 cm.

1980s and 1990s, the lights were on the whole night and, during the late 1990s, throughout the year.

28 specimens of *Penicillifera lactea* were collected between 1981 and 2004, in all months except June (Table 1). Moths were attracted to a 125 Watt mercury vapour lamp reflected off a white sheet. All these moths are in my collection at the above address.

Of these, specimens collected between late November and February exhibit some kind of melanism (see Figs. 1–4; the individual differences between “non-melanic” and “melanic” specimens are weaker expressed in the photographs than in the original specimens). Temperature from the week preceding the period of capture of the adult moths has been matched, where available.

In addition, the species was bred locally from wild collected larvae on *Ficus nemoralis* (Moraceae), to confirm that the moths being collected were not migrants. These moths have not been included in the above table since they constitute captive rearing and their date of emergence might not reflect their true rhythm in nature. However, all were bred in the summer months and all are non-melanic.

In order to confirm that the melanic and non-melanic forms belong to the same species, genitalia of one melanic (14. xi. 2003) and one non-melanic ♂ (11. xi. 1999) were examined. Both matched the ♂ genitalia illustrated by DIERL (1978: fig. 20) for *Penicillifera lactea*.

Observations

Minimum and maximum temperature was monitored for the period 20. xi. 1998 to 26. xii. 1998; 27. xii. to 2. i. 1999 and daily thereafter from 3. i. 1999 to 8. x. 2001.

Moths recorded between March and early November are normal in colouration (i.e., without melanistic colour). Although none of these moths was recorded during the summer months when temperature was being recorded, the years 1999, 2000 and 2001 were not very different from other years. The minimum temperature did not go below 13°C between March and early November during this period.

Specimens recorded between mid-November and February are all melanic. The moths did not appear in some winters, e.g. 2000–2001, 2001–2002 and 2002–2003.

The minimum temperature between 20. xi. 1998 and 26. xii. 1998 was 10°C; the maximum was 26°C. Melanic moths were recorded on 6. xii. 1998, 8. xii. 1998, 21. xii. 1998 and 22. xii. 1998.

The minimum temperature between 6. xi. 1999 and 11. xi. 1999 was 13°C. A normal ♂ moth was recorded on 11. xi. 1999 (genitalia examined).

The minimum temperature between 21. xi. 1999 and 28. xi. 1999 was 10.5°C. A melanic ♂ moth was recorded on 28. xi. 1999.

Penicillifera lactea (HUTTON 1865 [1864–66])

(Figs. 1–4)

Penicillifera lactea HUTTON (1865: 328, pl. xix, fig. 6 [larva]); type locality: Mussuree (= Mussoorie, Uttarakhand, India).

Distribution: From E. Afghanistan along the Himalaya to Assam; Andaman Is. (DIERL 1978).

Diagnosis: Generatio vernalis, aestivalis et autumnalis: distinguished from the following by the whitish thorax, abdomen and groundcolour of both wings.

Penicillifera lactea generatio hibernalis

Specimens examined: 12 ♂♂, 2 ♀♀: listed in Table 1 under “Melanic”. Leg. et coll. P. SMETACEK, Butterfly Research Centre, The Retreat, Jones Estate, Bhimtal, Uttarakhand, India. Latitude 29° 21' 17" N, longitude 79° 32' 34" E.

Forewing length: 16–20 mm.

Diagnosis: Antennae white, branches ochreous; head white; collar whitish; thorax and abdomen fuscous.

Recto surface: Forewing groundcolor fuscous; antemedial, medial, 2 postmedial and 1 submarginal costal dark marks giving rise to dark lines angled at veins 1A+2A, Cu1b, M2 and M1 respectively, the submarginal line not angled. Antemedial dark mark on inner margin. Discocellular veins pale with dark mark proximally and distally. Fringes dark.

Hindwing lower half fuscous, upper half paler. **Recto surface** with 3 dark marks on inner margin giving rise to 3 obscure dark lines extending as far as vein M1. Dark mark on discocellulars. Fringe dark up to vein Rs, pale above that.

Table 1: Collection data of specimens of *Penicillifera lactea*. All specimens recorded from Butterfly Research Centre, Jones Estate, 1500 m, Bhimtal, Kumaon Himalaya, Uttarakhand, India.

Normal specimens	Melanic specimens
12. xi. 2004 ♀	12. xi. 2003 ♂
2. iv. 1981 ♂	14. xi. 2003 2 ♂♂ (genitalia examined)
10. v. 2003 ♂	28. xi. 1999 ♂
30. v. 2002 ♀	6. xii. 1998 ♂
17. vii. 1995 ♂	8. xii. 1998 ♂
26. viii. 1995 ♂	13. xii. 2003 ♂
14. ix. 1995 ♀	16. xii. 2003 ♀
4. x. 1993 ♂	18. xii. 2003 ♂
x. 1993 ♂	21. xii. 1998 ♂
27. x. 1993 ♂	22. xii. 1998 ♂
2. xi. 2004 ♀	20. i. 2004 ♂
5. xi. 1995 ♀	10. ii. 2004 ♀
5. xi. 1998 ♀	22. ii. 2004 ♂
11. xi. 1999 ♂ (genitalia examined)	
15. xi. 2003 ♀	

Verso surface: both wings with pale costae and dark mark on discocellulars. Forewing with prominent postmedial and submarginal dark marks on costa, giving rise to curved dark lines.

Hindwing with postmedial and submarginal curved lines; tornus dark bounded by a pale line extending as far as vein Cu1b.

Discussion

Of the 14 specimens recorded between 12. III. and 11. XI., none are melanic. A single ♀ recorded on 15. XI. has a normal white groundcolour but the markings on the forewing are well developed. Of the 13 specimens recorded between 12. XI. and 22. II., all are melanic to varying degrees.

The temperature noted during the month of November in 1998 and 1999 suggests that when the minimum temperature was above 13 °C in the week preceding the date of capture of the specimen, normal specimens emerged, but when the minimum temperature went down to 10.5 °C in the week preceding the date of capture of an adult specimen, the specimen was melanic.

During January and February, the minimum temperature often goes down below 5 °C at night. All specimens recorded during these months are invariably darker (= melanic).

Normal moths of this species are on the wing through the summer and monsoon months when relative humidity varies from 5% to 45% indoors. Melanic moths are on the wing between late November and February when relative humidity indoors varies between 6% and 20%. Since there is a large overlap between these two sets of figures, it is unlikely that humidity plays a major role in determining melanism in this species.

Conclusion

Melanism has been observed to be temperature controlled in certain groups of butterflies, e.g. the Vanessidae (Nymphalidae) and the Pierinae (Pieridae) (FORD 1955). It is likely that it is the controlling factor of melanism in *Penicillifera lactea*, too. This phenomenon does not appear to have been reported for this family earlier.

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